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Before the

**Subcommittee on Energy and Water Development
Committee on Appropriations
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Mr. Chairman, Ranking Member Frelinghuysen, and Members of the Committee, thank you for the opportunity to appear before you today to discuss the President's fiscal year 2011 budget request for the Office of Nuclear Energy at the Department of Energy.

In his State of the Union address earlier this year, President Obama said, "To create more of these clean energy jobs, we need more production, more efficiency, more incentives. And that means building a new generation of safe, clean nuclear power plants in this country." On February 16, the President announced conditional commitments for more than \$8 billion in loan guarantees for that very purpose.

The President's fiscal year 2011 budget request also supports nuclear power by requesting an additional \$36 billion in loan guarantee authority for new nuclear plant construction. In addition, the budget request includes \$912 million for the Office of Nuclear Energy, a \$42 million increase over the fiscal year 2010 appropriation of \$870 million. Of the fiscal year 2011 request, \$495 million is for research and development to continue to make major improvements in the economic competitiveness, environmental performance, and proliferation resistance of nuclear energy deployed in the United States and abroad. This research budget will help build a foundation for nuclear power's future in the United States. We must further engage the country's intellectual capacity to find new solutions to the challenges in front of us.

President Obama has said that, "The nation that leads the world in creating new sources of clean energy will be the nation that leads the 21st century global economy." I share this view and believe that nuclear energy must be part of our clean energy mix. The construction of new nuclear reactors, such as those that we have provided loan guarantees for, will create thousands of good paying jobs in the United States and produce electricity to power our economy.

PROGRAMS

We have re-organized our research budget into three main programs: (1) Reactor Concepts Research, Development and Demonstration, (2) Nuclear Energy Enabling Technologies, and (3) Fuel Cycle Research and Development. The Office of Nuclear Energy has also put in place coordinating entities to prevent research duplication among program activities and to ensure that the activities complement one another.

Reactor Concepts Research, Development and Demonstration

The fiscal year 2011 budget includes \$195 million for the Reactor Concepts Research, Development and Demonstration (RD&D) program. The mission of this program is to develop new and advanced reactor designs and technologies to broaden nuclear energy's applicability, improve its competitiveness, and ensure its lasting contribution in meeting our nation's energy and environmental challenges.

Small Modular Reactors

The high capital cost for new nuclear reactors has been a challenge for private entities to finance. Smaller reactors would carry lower investment risk, and offer potential advantages in the way they are sited, licensed, financed, manufactured, and built. Modular reactors could be linked together to create a larger power plant. This would allow the owner of a reactor the flexibility to incrementally add power in response to rising demand.

Also, SMRs can provide power for applications where large plants are not needed or may not have the necessary infrastructure to support a large unit such as smaller electrical markets, isolated areas, smaller grids, or restricted water or acreage sites. I think small modular reactors represent an important opportunity to grow U.S. manufacturing and support a new generation of nuclear power plants that would provide many good paying jobs.

The fiscal year 2011 budget request includes \$39 million to support small modular reactor research and development, and includes an effort to consider and identify the most cost effective, efficient, and appropriate mechanisms to support further development of the technology.

Next Generation Nuclear Plant

The 2005 Energy Policy Act authorized the Next Generation Nuclear Plant (NGNP) project. Since then, the Department has coordinated a public - private partnership to demonstrate a high-temperature gas reactor technology.

As we address the issues of climate change, it is useful to understand and consider options for nuclear energy to safely and economically contribute to reduced carbon emissions outside the electricity sector

High temperature gas reactors like NGNP could potentially generate large quantities of low-carbon heat for highly efficient electricity generation and co-generation of process heat applications in industries such as petrochemical, petroleum, and fertilizer production.

The fiscal year 2011 budget request includes \$103 million for the NGNP project.

The project is being conducted in two phases. Phase 1 is comprised of conceptual design, development of licensing requirements, cost and schedule estimates for demonstration project completion and a business plan for integrating Phase 2 activities. The Secretary of Energy will use the information and data gathered in Phase 1 as a basis for determining whether the project should continue to Phase 2. Phase 2 would entail detailed design, license review and construction that would lead to a demonstration plant.

Earlier this month, the Department announced merit-based selections for Phase 1 awards to two teams led by Pittsburgh-based Westinghouse Electric Co. and San Diego-based General Atomics for conceptual design and planning work for the Next Generation Nuclear Plant. Negotiations are now in progress with these two teams which, if successful, will result in cost-shared awards of approximately \$40 million of Department funds.

Light Water Reactor Sustainability

The U.S. nuclear fleet has maintained a 30-year record of exceptional safety and performance. Industry has significant financial incentive to keep existing plants running. As a result, the utility owners of almost all of these plants are planning or have applied for license renewals that will extend the operating life of their plants from 40 to 60 years.

Over the last couple of years, the Office of Nuclear Energy, along with its lead laboratory, Idaho National Lab, as well as other national laboratories, has launched a research effort with industry aimed at providing the technical underpinnings for decisions on operating the Nation's existing fleet beyond 60 years. The fiscal year 2011 budget request includes \$26 million for the Light Water Reactor Sustainability program. Given the private sector incentives, cost sharing will be used the maximum extent possible.

Advanced Reactor Concepts

This program includes activities performed under the existing Generation IV research and development program but is expanded to also encompass reactor technologies beyond Generation IV. The program will focus on reactors that could dramatically improve performance in sustainability, safety, economics, security, and proliferation resistance.

Both advanced thermal and fast reactor systems will be investigated in the context of long-term waste management. The fiscal year 2011 budget request for advanced reactor concepts research is \$22 million.

Nuclear Energy Enabling Technologies

Secretary Chu has stated that “we have many technologies in hand today to begin the transition to a low-carbon economy, but we will need breakthroughs and better technologies to meet our long-term goals.” As we look forward to the next leap forward in nuclear reactor and fuel cycle technologies, a strong investment is needed in research and development that underpins and crosscuts nuclear energy technology requirements. In that spirit, the budget request includes \$99 million for the Nuclear Energy Enabling Technologies program, which will provide support for achieving those breakthroughs by funding innovative ideas related to any aspect of nuclear energy technology as well as focusing on specific areas of research where breakthroughs could have major impacts on a variety of reactor designs.

Crosscutting Technology Development

The fiscal year 2011 budget request includes \$43 million for Crosscutting Technology Development, which will support innovative research programs in the following areas

- **Reactor Materials:** New alloys and materials could enable transformational reactor performance
- **Proliferation Risk Assessment:** New tools and approaches could improve the understanding and management of proliferation risks and physical security risks for different fuel cycle options
- **Advanced Methods for Manufacturing:** Advanced manufacturing techniques, such as those employed in the oil, aircraft, and shipbuilding industries, could help bring down costs for new nuclear plant construction
- **Advanced Sensors and Instrumentation:** New sensors and instrumentation could enhance nuclear plant safety and performance

Careful screening of results will ensure that promising developments are considering in program and strategic planning and incorporated into reactor and fuel cycle ongoing programs as appropriate.

Transformative Nuclear Concepts Research and Development

A key element in the Office of Nuclear Energy’s effort to encourage out-of-the-box thinking and promote creative solutions to the universe of nuclear energy challenges and questions is the Transformative Nuclear Concepts Research and Development program. The fiscal year 2011 budget request includes \$29 million to support investigator-initiated projects that relate to any aspect of nuclear energy generation—reactor and power conversion technologies, enrichment, fuels and fuel management, waste disposal, nonproliferation, and so forth—ensuring that good ideas have sufficient outlet for exploration. This effort will be coordinated with Office of Science activities.

To encourage broad participation across national laboratories, universities, research institutions, and industry, solicitations would be open, competitive and peer reviewed. Increased emphasis will be placed on including applied scientists and engineers not routinely included in NE research programs. Awards would likely span 2-3 years, depending upon project scope. Peer reviews of applications will be carried out by a body of internal and external experts to help select promising concepts, and to ensure that activities are not duplicative of existing R&D activities. NE will monitor progress, utilize results to inform and adjust its program and activity planning and strategy development, and ultimately consider the outcomes of funded activities within the context of its mission-specific activities.

Energy Innovation Hub for Modeling and Simulation

The Energy Innovation Hub for Modeling and Simulation will be modeled after highly successful endeavors, such as Bell Labs and the Bioenergy Research Centers. It will utilize existing advanced modeling and simulation capabilities developed by the Department of Energy's Office of Science and National Nuclear Security Administration, and other Department of Energy research and development programs, as well as develop new capabilities.

A Funding Opportunity Announcement was released in early 2010 to initiate a competitive selection process. In fiscal year 2010, the Department expects to select an applicant and award a Cooperative Agreement contract for five years with the possibility of a five-year extension. The fiscal year 2011 budget request includes \$24 million to support the Hub's activities and provide for an ongoing review of the Hub's deliverables and performance. The modeling and simulation tools that will be developed will eventually be applied to perform virtual modeling of an existing, operating reactor and will be applicable to advanced reactors.

Fuel Cycle Research and Development

The fiscal year 2011 budget request includes \$201 million for Fuel Cycle Research and Development to perform goal-oriented, science-based R&D to provide options for decision-makers for future commercial fuel cycle management strategies. This will enable the safe, secure, economic, and sustainable expansion of nuclear energy while minimizing proliferation risks.

The program will conduct R&D related to three potential long-term fuel cycle scenarios—once-through, modified open, and full recycle—to provide future decision-makers with information to make decisions on how best to manage used fuel.

- **Once-Through:** In this scenario, nuclear fuel makes a single pass through a reactor, after which the used fuel is removed, stored for some period of time, and then directly disposed in a geologic repository for long-term isolation from the environment. DOE R&D related to this scenario would include the development of fuels for use in present and Generation III+ reactors that would increase the

efficient use of uranium resources and reduce the amount of used fuel for direct disposal.

- **Modified Open Cycle:** In this scenario, limited separations and fuel processing technologies would be applied to the used fuel to create fuels that enable the extraction of much more energy from the same mass of material, while at the same time accomplishing waste management goals. DOE R&D in this area focuses on the investigation of fuel forms, reactors, and fuel/waste management approaches that could dramatically increase the utilization of fuel resources and reduce the quantity of long-lived radiotoxic elements in the used fuel to be disposed. Technologies will be considered that require at most limited separation steps and minimize proliferation risks.
- **Full Recycle:** In this scenario, fissionable and fertile elements of used fuel would be recycled in thermal- or fast-spectrum systems to reduce the radiotoxicity of the waste placed in a geologic repository while more fully utilizing uranium resources. In a full recycle system, only those elements that are considered to be waste (primarily the fission products) would be disposed. DOE's R&D in this area would focus on developing techniques that will enable specific elements to be repeatedly recycled and developing a cost-effective and low-proliferation-risk approach that would dramatically decrease the long-term challenges posed by the waste and reduce uncertainties associated with its disposal.

It is important to note that there many technical challenges in the modified open and full recycle scenarios. The full recycle fuel cycle has been the focus of the Fuel Cycle R&D program to date and the once-through fuel cycle is the current practice in the United States. The modified open cycle constitutes a range of technology options in between once-through and full recycle. The modified open cycle has not been studied in as much depth and that is why it is being introduced as a new focus area in fiscal year 2011. There are many exciting and plausible ideas that have emerged, leading to a request for substantial funding in this, its first year.

A key issue that cuts across all potential future fuel cycle scenarios is disposal of high level radioactive waste from reactors and fuel cycle facilities. No matter what fuel cycle is ultimately chosen, disposal will be required. The FY 2011 budget request demonstrates this priority by providing \$45 million for significantly increased R&D efforts in this area. NE will expand research and technology development to identify and analyze options for storage, transportation, and disposal of used nuclear fuel and all radioactive wastes generated by existing and future nuclear fuel cycles.

The Administration has determined that the Yucca Mountain repository is not a workable option and has decided to terminate the Office of Civilian Radioactive Waste Management. The Department of Energy has submitted a motion to withdraw with prejudice its application to the U.S. Nuclear Regulatory Commission for a license to construct a high-level waste repository at the Yucca Mountain site. The Administration is committed to fulfilling its obligations under the Nuclear Waste Policy Act (NWPA);

funding to support the core functions and staff under the NWPA is included in the Office of Nuclear Energy's FY 2011 budget request.

Within the Fuel Cycle R&D program, funds are requested to support transfer of engineering and scientific expertise used for the Yucca Mountain Project from the Office of Radioactive Waste Management to the Office of Nuclear Energy. This expertise augments NE's ability to investigate alternative storage and disposal approaches, including the options for high-level waste disposition.

The Administration has established a Blue Ribbon Commission on America's Nuclear Future to conduct a comprehensive review of the back end of the fuel cycle, which is co-chaired by General Brent Scowcroft and Congressman Lee Hamilton. The commission will produce a final report within two years that will provide recommendations for developing a safe, long-term solution to managing the Nation's used nuclear fuel and nuclear waste. The Office of Nuclear Energy will provide support to the Commission as requested.

International Nuclear Energy Cooperation

The Office of Nuclear Energy, through the International Nuclear Energy Cooperation (INEC) program, will further its mission through bilateral and multilateral agreements and other mechanisms. The goals are to foster the safe, reliable, and environmentally sustainable use of nuclear energy and to minimize the risks of proliferation.

INEC will serve as the central coordinating program for international engagement within the Office of Nuclear Energy and will support the Office in international policy interactions with other government agencies and Departmental offices. INEC will work with the Office of Nuclear Energy's R&D programs, in coordination with other governmental entities as needed, on the development, negotiation, and execution of international bilateral and multilateral agreements; the provision of policy analysis and guidance on U.S. international civil nuclear activities; and support for international nuclear energy cooperation and initiatives. This may also include evaluation of domestic and international frameworks to engage other nations in civil nuclear energy cooperation and promote best practices in the safety, regulatory, and security issues associated with civil nuclear energy. The fiscal year 2011 budget request includes \$3 million for International Nuclear Energy Cooperation. The funds will support carrying out bilateral and multilateral agreements and in facilitating international discussion, negotiations, and related analyses on a range of international nuclear energy concerns.

RE-ENERGYSE

The fiscal year 2011 budget request for the Office of Nuclear Energy includes \$5 million for the Department of Energy's RE-ENERGYSE (Regaining our Energy Science and Engineering Edge) program to provide the education and training necessary to build a highly skilled clean energy workforce that will support nuclear power by solving current and future challenges.

RE-ENERGYSE supports university nuclear engineering programs through scholarships and fellowships. These fellowships will complement existing Federal efforts and will help ensure that the next generation of scientists and engineers are available to support existing and future nuclear energy generation capacity and provide necessary innovation.

In addition to RE-ENERGYSE funding, the Office of Nuclear Energy will designate up to 20 percent of funds appropriated to its R&D programs for work to be performed at university and research institutions.

Radiological Facilities Management

The fiscal year 2011 budget request includes \$67 million for the Radiological Facilities Management (RFM) program. Within the RFM budget, \$47 million is for the Space and Defense Infrastructure subprogram to support the production of radioisotope power systems (RPSs). This funding maintains specific nuclear facilities at Idaho National Laboratory, Oak Ridge National Laboratory, and Los Alamos National Laboratory. These facilities are managed by the Office of Nuclear Energy.

The Department of Energy has the unique statutory authority to design, build and furnish RPSs to federal users. These systems have enabled deep space exploration and national security applications for nearly five decades. RPSs convert the heat from the decay of the radioactive isotope plutonium-238 (Pu-238) into electricity. RPSs are capable of producing either heat or electricity for decades under the harsh conditions encountered in deep space. Pu-238 fueled RPS's have provided power for 26 different missions that NASA has flown over the years, most of which would not have been possible without the radioisotope power sources that require this particular fuel and they have proven to be safe, reliable, and maintenance-free.

Two new advanced RPSs that would use Pu-238 are under development at NASA: the Multi-Mission Radioisotope Thermoelectric Generator and the Advanced Stirling Radioisotope Generator. Both advanced RPSs could support missions in the vacuum of space or in planetary atmospheres.

In the past, the Department of Energy obtained Pu-238 from the Savannah River Site K Reactor, which was taken off-line in the late 1980s and is now shut down. More recently, the Department has augmented its available inventory for non-national security applications by purchasing Pu-238 from Russia, but those stocks are limited and Russia is no longer producing Pu-238. Only a limited amount of Pu-238 remains available for U.S. purchase under the current contract with Russia, however the ability to obtain this material is not certain and the contract expires in January 2013.

The Department of Energy maintains the statutory responsibility for the safe and secure operations to produce special nuclear material. Beginning in FY 2011, DOE and NASA will initiate a project to restart the production of plutonium-238 (Pu-238) for future NASA uses and potential national security applications. The DOE budget request for the

plutonium-238 Production Restart Project subprogram is \$15 million which is matched by another \$15 million in the NASA budget request.

Within the Radiological Facilities Management program, funding is also requested for the Research Reactor Infrastructure subprogram, which provides fresh reactor fuel to and removes used fuel from 26 operating university reactors.

Idaho Nuclear Infrastructure

The Office of Nuclear Energy focuses on supporting research with the most appropriate and best talent in the nation. Our programs are broad and wide, with participation from national laboratories, industry and universities. However it is important to have a lead institution. The Idaho National Laboratory (INL) serves as the center for U.S. nuclear energy research and development efforts. INL utilizes and incorporates expertise of government, industry, and academia into their laboratory programs dedicated to the development of advanced reactor and fuel-cycle technologies.

INL employs more than 3,900 personnel located primarily at the Idaho Site and in the city of Idaho Falls. In addition to its broad spectrum of nuclear energy and national security programs, the laboratory provides essential site services to DOE and other governmental agencies and private-sector companies doing business on the Idaho Site. INL conducts science and technology research across a wide range of disciplines.

Under the oversight of the Department's Office of Nuclear Energy, INL provides technical leadership to support long-term nuclear science and engineering R&D activities to address the Nation's energy and nuclear security goals. Key technical areas include nuclear fuel cycle science-based research, the development of alternative radioactive waste management strategies for the United States, and technology programs that support nuclear nonproliferation and other critical infrastructure protection.

INL also conducts R&D and technical integration support for the new Reactor Concepts Research, Development and Demonstration and the Fuel Cycle Research and Development program. INL is the lead laboratory for the Next Generation Nuclear Plant program and, together with Oak Ridge National Laboratory, is the principal laboratory responsible for the development of advanced gas reactor fuel and materials R&D. INL is also responsible for staffing the Technical Secretariat for the Generation IV International Forum.

INL provides technical support for cross-cutting technologies including advanced fuels, fabrication and construction methods, and proliferation risk assessment within the new Nuclear Energy Enabling Technologies program. INL has the lead on the development of advanced instruments and sensors for the existing light water reactor fleet.

Two programs support the nuclear infrastructure at INL:

- The Idaho Facilities Management Program maintains its research facilities in a safe, reliable, and environmentally compliant condition to support national nuclear programs. The fiscal year 2011 budget request for this effort is \$162 million. Through the National Scientific User Facility effort, the Office of Nuclear Energy has opened the Advanced Test Reactor and its Post Irradiation Examination Facilities to universities, national laboratories, industry and other federal agencies.
- The Idaho Site-Wide Safeguards and Security Program supports activities that are required to protect the assets of the Idaho complex from theft, diversion, sabotage, espionage, unauthorized access, compromise, and other hostile acts. This program is funded under the Other Defense Activities Appropriation. The fiscal year 2011 budget request is \$88 million.

Program Direction

Program Direction provides the Federal staffing resources and associated costs required to provide overall direction and execution of the Office of Nuclear Energy. The budget request for fiscal year 2011 includes \$91 million for Program Direction. In addition to these appropriated funds, the Office of Nuclear Energy also manages approximately \$70 million dollars annually in reimbursable funding from the National Aeronautics and Space Administration and the Department of Defense for the development of advanced radioisotope power systems for space exploration and national security missions.

Program Direction also supports the transition of management and oversight responsibilities for the Nuclear Waste Policy Act from OCRWM, including core functions pertaining to administration of the Nuclear Waste Fund, management of the standard contracts between nuclear utilities and the government, and management and oversight of R&D activities focused on used nuclear fuel disposition and high-level waste management.

CONCLUSION

Mr. Chairman, that concludes my written testimony. I appreciate the opportunity to appear before you to present the Office of Nuclear Energy's FY 2011 budget request, and I am happy to answer any questions that you or any other Members of the Committee may have.